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**Class I Area Impact
Analysis Protocol**

**Calciners A & B Fuel
Switch**

**SOLVAY SODA ASH JV
GREEN RIVER, WY**

PROJECT NO. 170-4
November 2002

SOLVAY2016_1.3_000221



The State
of Wyoming



Department of Environmental Quality

Dave Freudenthal, Governor

Herschler Building • 122 West 25th Street • Cheyenne, Wyoming 82002

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February 10, 2003

Ms. Dolly Potter
Environmental Manager
Solvay Minerals
Green River Soda Ash Plant
P.O. Box 1167
Green River, Wyoming 82935

Re: Class I Protocol Review
Solvay Minerals Calciner A & B Fuel Switch

Dear Dolly:

On 11/27/02, the Division received the Class I Area Impact Analysis modeling protocol for the Solvay Minerals Calciner A & B Fuel Switch. Since this facility is an existing major source, the proposed increases in several criteria pollutant emissions associated with this modification will trigger the requirements of Wyoming Air Quality Standards and Regulations, Chapter 6, Section 4 - Prevention of Significant Deterioration.

The Division has completed the review of the Class I dispersion modeling protocol and the following comments address the additional information and clarifications which are needed in the air quality modeling protocol to be submitted to the Wyoming Air Quality Division:

1. Section 1.0, page 1, 4th paragraph of the Class I Area modeling protocol states that impacts on two Air Quality Related Values (AQRVs): visual range and acid neutralization capacity, will be estimated generally following the Federal Land Managers Air Quality Related Values Work Group (FLAG) Phase I Report.

The visual range and acid neutralization capacity analyses are typically conducted using various methodologies that are specified in several available guidance documents as well as the FLAG guidance document. Therefore, the Class I area modeling protocol must specifically reference the pertinent sections of the FLAG Phase I Report and other guidance documents that will be adhered to in conducting the proposed visual range and acid neutralization capacity analyses, as the Division does not endorse all of the guidance and methodologies provided in the FLAG Phase I Report.

2. Section 3.0, page 6 of the Class I Area modeling protocol states that a demonstration of insignificant impact at the Bridger and Fitzpatrick Class I areas will be conducted for the proposed modification; the significance determination will be based on comparing the modeled impact using a refined level CALPUFF analysis to the proposed EPA Class I Significant Impact Levels (SILs) as provided in Table 3.1 of the protocol.

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The Division recognizes the use of the Class I SILs for determining whether a source has an insignificant impact at Class I areas. However, in the event that the CALPUFF refined modeling analysis demonstrates a significant impact at the Bridger or Fitzpatrick Class I areas, the protocol must address what additional analyses will be conducted, and must also provide specific details regarding how the additional CALPUFF refined analyses will be conducted.

3. Section 4.1, page 8 of the Class I Area modeling protocol states that only seasons with less than 50% of the IMPROVE monitor data were used in determining the seasonal 20th percentile extinction values for the Bridger Wilderness Area.

This paragraph contains a typographical error, and the paragraph should instead state that only seasons with a data capture of greater than 50% will be used in constructing the seasonal extinction values.

4. Section 5.0, page 10, first paragraph of the Class I Area modeling protocol states that the increment-consuming or increment-expanding emissions will be calculated as the difference in emissions between the most recent available potential emission rates and the potential emission rates as of the baseline date.

The Division is in the process of preparing draft guidance on the methodologies for calculating increment consumption, and this guidance will be provided in a separate response from the Division on this issue.

5. Section 6.3, page 14, first two full paragraphs in the Class I Area modeling protocol, it was proposed that terrain-based relative humidity (RH) data values would be derived from the RH data contained in the MM5 analysis fields, and that a further derivation to obtain spatially averaged RH data values would be conducted if there were considerable discrepancies between the RH values in the MM5 analysis fields and the surface station RH values contained in the SWWYTAF CALMET.DAT file.

While the Division recognizes that the RH data used in the SWWYTAF analysis were not handled consistently in the CALPUFF and CALPOST models, the SWWYTAF analysis was not a regulatory-based analysis completed for a new source under the New Source Review program. Current guidance and practice does not allow for the use of terrain-based derivations of RH data, nor has the proposed RH data derivation methodology been approved by the EPA or the Division. Hence, the Division will not allow the use of the SWWYTAF modified VIS.DAT file to be used in the visibility analysis, and will require that the surface station specific RH data contained in the SWWYTAF CALMET.DAT file be utilized in its current representation in all CALPUFF simulations.

The handling of RH data in the CALPOST model to calculate light extinction is a different matter. CALPOST has several options for utilizing RH data in these calculations, including a direct import from the CALMET.DAT file to calculate the relative humidity adjustment factors [f(RH)], and user-specified f(RH) values that are independent of the RH data used in the CALPUFF simulations for calculating sulfate and nitrate formation. To be consistent with the

Solvay Minerals Class I Protocol Review
Calcliner A & B Fuel Switch
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methodologies to be used in assessing regional haze under the Regional Haze Rule, the Division will require the use of the monthly $f(RH)$ values specified for the Bridger Wilderness Area, and the Fitzpatrick Wilderness Area, respectively, as provided in Appendix A of the EPA document, Draft Guidance for Tracking Progress Under the Regional Haze Rule (September, 2001).

6. Section 7.1, page 17, second paragraph in the Class I Area modeling protocol proposes to use a maximum RH value (RHMAX) of 95%, since RH data above 95% are not well quantified and RH data above 95% are unreliable for determining changes in light extinction.

The Division has specified the use of monthly $f(RH)$ values to be used in the CALPOST simulations for calculating changes in light extinction, and the use of the monthly $f(RH)$ values will eliminate the need to adjust the RHMAX parameter.

If you have any questions regarding air quality modeling related issues, please feel free to contact me at (307) 777-6188. All other permitting issues should be directed to Chad Schlichtemeier or Bernie Dailey at (307) 777-7391.

Sincerely,



Ken Rairigh
Air Quality Engineer

cc: Bernard J. Dailey
Tony Hoyt

February 3, 2003

Project No. 170-4



AIR SCIENCES INC.

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Mr. Ken Rairigh
Department of Environmental Quality
Herschler Bldg, 122 W 25th Street
Cheyenne, WY 82002

Subject: Modifications to Solvay Class II Modeling Protocol Submitted Dec 12, 2002

Dear Ken:

In response to your January 21, 2003 review of the December 12, 2002 Solvay Class II Impacts Modeling Protocol, Solvay is providing this modification to the protocol. Modifications are listed in the order of your comments.

1. Ozone modeling if Screening Tables do not show compliance:

The Scheffe method is a simple screening lookup table approach that uses the maximum daily VOC emission rate and the ratio of the VOC to NO_x emissions to determine the maximum incremental ozone impact from a single source. The approach uses two tables: one for urban environments and one for rural environments. Since the region around Solvay is rural, the rural table will be used.

If the Scheffe method results in an impact greater than the Wyoming 1-hour ozone standard, then the Reactive Plume Model version IV (RPM-IV Version 93267) will be used. A previous version of RPM was used to develop the Scheffe screening tables. The RPM-IV is an EPA alternative model used to model plume dispersion and non-linear photochemistry from an individual plume. The RPM is a Lagrangian model that represents an air parcel of pollutants as it moves downwind, simulating the entrainment of ambient (background) air and the resulting chemical transformations within the plume. RPM-IV uses the Carbon Bond Mechanism IV (CBM-IV) for the chemistry, although other chemical mechanisms can be used by changing the input file.

RPM-IV will be set up to simulate rural conditions using the ambient and plume mode. A review of the hourly ozone concentration data collected from the Green River Basin Visibility study will be used to identify three days of high ambient ozone to evaluate. Regional VOC emissions (with speciation) will be extracted from the Community Modeling Air Quality (CMAQ) modeling being conducted by the Western Regional Air Partnership (WRAP).

Mr. Ken Rairigh
Page 2
February 3, 2003



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2. Highest sixth-high for comparison with standards:

Demonstration of PM₁₀ compliance with the NAAQS will be achieved by using the highest fourth-high over three consecutive years of Rock Springs meteorological data. In order to use the five-year data set, the three three-consecutive-year periods will be run (as in a rolling 3-year analysis). The highest of these three fourth-high values will be compared with the PM₁₀ standard. We believe the EPA modeling guidelines are ambiguous on how this can be performed, but your recommendation is one appropriate interpretation.

Compliance with the short-term PM₁₀ Class II PSD increment will be demonstrated by modeling five years of meteorological data one year at a time and comparing the highest of the annual highest-second-high concentrations to 30 µg/m³.

3. Removal of nearby increment-consuming sources:

The increment consumption modeling (if impacts are significant) will include all increment-affecting sources located in the impact area of the proposed modification, and all increment-affecting sources located within 50 km of Solvay's impact area, as you recommend.

We appreciate your time and effort in providing this critique of the December modeling protocol.

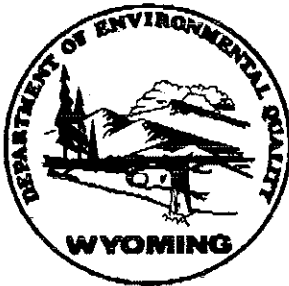
Sincerely,

Air Sciences Inc.

Rodger G. Steen

cc: Dolly Potter - Solvay
Kent Norville - Air Sciences

SOLVAY2016_1.3_000226



DEPARTMENT OF ENVIRONMENTAL QUALITY
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FAX TRANSMITTAL COVER SHEET

No. of Pages: 4 (Cover Sheet Included)

DATE: 2/12/03

TO: Dolly Potter

PHONE NO.: (307) 872-6571 FAX NO.: (307) 872-5876

FROM: Ken Rairigh PHONE NO.: (307) 777-6188

COMMENTS: Dolly,

Air Quality Division's response to Solvay's Class I protocol.

The first fax didn't make it to you since I was using an old fax number, so I am resending using the fax number Solvay provided this morning.

Ken

IF YOU DID NOT RECEIVE ALL OF THE PAGES, PLEASE NOTIFY
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Appendix A: Proposed Source 17 Emissions Evaluation

List of Acronyms

ANC	Acid Neutralization Capacity
AQRV	Air Quality Related Value
DEQ	Wyoming Department of Environmental Quality
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FS	Forest Service
IMPROVE	Interagency Monitoring of Protected Visual Environments
IWAQM2	Interagency Workgroup on Air Quality Modeling (2 nd)
MM5	Fifth-Generation NCAR/Penn State Mesoscale Model
SWWYTAF	Southwest Wyoming Technical Air Forum
USDA	U.S. Dept. of Agriculture
VR	Visual Range

INTRODUCTION

Solvay Soda Ash JV (Solvay) proposes to modify two of its calciner combustion systems (Calciners A and B, also known as Source 17) to be fired on coal instead of natural gas, the current fuel. Source 17 was fired on coal through 1995, when the natural gas burners were installed. This proposed calciner fuel switch will cause an increase in potential NO_x and PM_{10} emissions. A permit application will be filed with the Wyoming Department of Environmental Quality (DEQ) for the modification of this facility. As a part of the environmental impact assessment, the anticipated impacts from this modification on nearby Class I areas are to be evaluated, and this protocol describes the proposed methods for this impact evaluation. Specifically, the impacts will be evaluated in relation to: 1) Class I PSD increments and 2) adverse impact thresholds for Air Quality Related Values (AQRVs).

This protocol describes the proposed facility modifications, proposed methods for evaluating the associated Class I impacts, the assumptions to be made in the evaluation, baseline and natural background conditions, the relevant ambient standards, and USDA Forest Service recommended impact thresholds.

Solvay is located in Sweetwater County of Southwestern Wyoming in Section 31, T18N, R109W, and at coordinates 41.4942 degrees N and 109.7615 degrees W. There are two wilderness areas within a 200-km radius of Solvay; they are the Bridger and adjacent Fitzpatrick Wilderness Areas. Solvay is at an elevation of about 6,200 feet, 85 miles (136 km) south-southwest of the closest point of the nearer wilderness area, which is Bridger. These wilderness areas are mostly at a high elevation and contain the Wind River Range, which rises to over 13,000 feet at the north end. The facility location along with the Class I areas in the region are shown in Figure 1.1. Figure 1.1 also shows the locations of the towns in the region. The closest town to the facility is Green River (population 13,000), located about 20 miles east. Other towns close to the facility are Rock Springs (35 miles east, population 19,400), Kemmerer (50 miles northwest, population 3,000), and Evanston (65 miles southwest, population 11,400). Figure 1.2 shows the west view of the facility, and the combined stack for Calciners A and B is identified.

The CALPUFF modeling system will be used to estimate concentrations within the Class I areas, including Class I PSD increment consumption, following for the most part the Southwest Wyoming Technical Air Forum (SWWYTAF) methods. The 1995 SWWYTAF data sets will also be used to generate the regional wind field. Impacts on the two AQRVs of visual range (VR) and acid neutralization capacity (ANC) will be estimated generally following the FLAG 2000 guidelines. Since these areas are beyond 50 km, impacts in the form of distinct plume characteristics (contrast) will not be considered an issue (FLAG 2000, Section D, 2, c, Near Field Analysis).

Figure 1.1: Solvay Location and Nearest Class I Areas

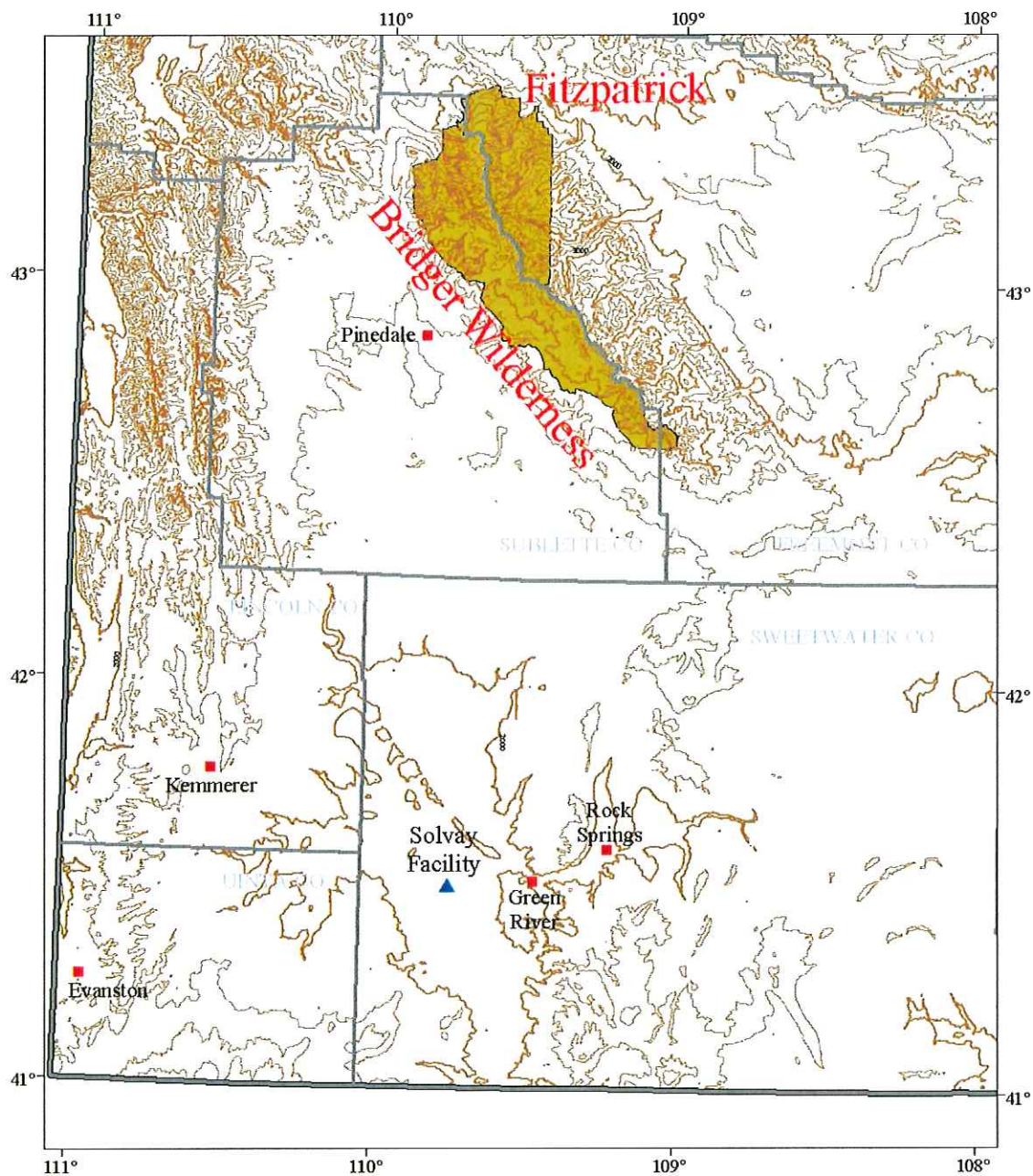
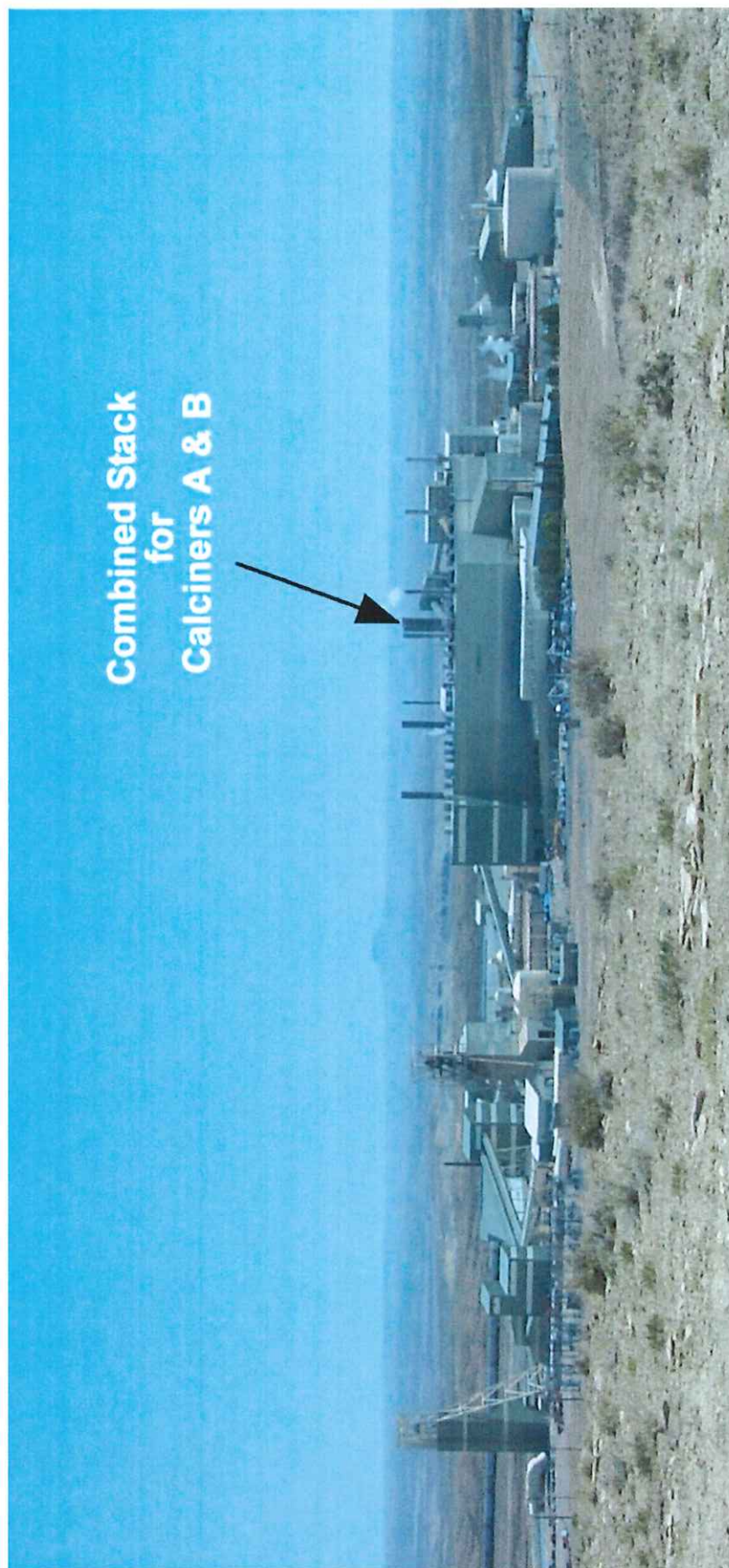


Figure 1.2: West View of Facility



SECTION 2.0

CHARACTERIZATION OF THE FACILITY

Solvay is an existing underground trona mine with surface processing facilities. The trona ore (sodium sesquicarbonate dihydrate [$\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$]) is processed into sodium-based products, including soda ash (sodium carbonate [Na_2CO_3]). Construction of the facility began in 1979, and it became operational in 1982. Its sources consist principally of calciners, dryers, boilers, and material handling processes. The facility is presently permitted under Operating Permit 30-126 and has a potential to emit 405 tpy of particulate matter (PM_{10}); 619 tpy of sulfur dioxide (SO_2); 2,440 tpy of nitrogen oxides (NO_x); 2,464 tpy of volatile organic compounds (VOC); and 7,431 tpy of carbon monoxide (CO). There are four gas-fired calciners, two gas-fired dryers, two coal-fired boilers, and other smaller gas-fired combustion units. The purpose of the calciners is to convert the trona ore to a crude soda ash by driving off the CO_2 and H_2O .

Solvay is proposing to convert Calciners A and B (Source 17) from natural gas-firing to coal-firing. These calciners are vented to a common stack with the stack parameters provided in Table 2.1. Potentials to emit and 2000/2001 actual emissions are shown in Table 2.2. From Table 2.1 it is apparent that with the shift to coal-firing, there will be a 20-percent reduction in the heat rate, but an increase in airflow, resulting in a substantial increase in airflow per unit of heat. The other stack parameters will remain the same.

Table 2.1: Source 17 Physical Stack Parameters

Description	Present	Proposed
Height	180.5 ft	180.5 ft
Heat Rate	500 MMBtu/hr	400 MMBtu/hr
Exit Diameter	12 ft	12 ft
Exhaust Velocity	44 ft/sec	96 ft/sec
Exhaust Temperature	375°F	400°F
Flow Rate	312,000 ACFM	650,000 ACFM
Location	603,686 m (East)	Unchanged
	4,594,808 m (North)	Unchanged

The 2000/2001 averaged actual emission rates and permitted potential to emit (PTE) for Source 17 are provided in columns 2 and 3 of Table 2.2. The proposed PTE under coal-firing of Source 17 is listed in column 4. For purposes of determining the triggering of "Major Modification" (Wyoming Air Regulations, Chapter 6, Section 4(a)(x)) source review requirements, Sub-section xii requires a calculation of the "net emissions increase," which is the difference between the proposed PTE and the present actual emissions. The review threshold amounts are listed in column 5. The Net Emissions Increase is provided in column 6. From this it is apparent that NO_x , CO, PM_{10} , and VOC emissions are to be reviewed by the Major Modification or Chapter 6,

Section 4 review procedures. These include Class I area impact analyses (Section 4(b)(vi) and (vii)). This protocol addresses the methods for evaluating the Class I area impacts.

Table 2.2: Source 17 Emission Rates (tpy)

Pollutant	Present Actual Emissions*	Present Potential to Emit	Proposed Potential to Emit	MM Review Threshold	Increase from Present Actual to Proposed PTE	MM Review Triggered?
NO _x	49.2	131.4	788	40	739	Yes
CO	1,077	6,675	5,533	100	4,455	Yes
PM ₁₀	32.4	97.7	180	15	148	Yes
VOC	1,199	3,399	2,710	40	1,510	Yes

* Average of years 2000 and 2001

Comparing present potential with proposed potential to emit, the increased NO_x emissions are due to an increase in the emission factor (mass of NO_x per unit of heat) for the stoker-coal burner, which has inherently less complex flame temperature control. Although there will be sulfur in the coal, the trona ore will effectively absorb all of it during the calcination process, which was previously demonstrated by stack tests when Source 17 was originally fired on stoker-coal. (Note that trona and soda ash are commonly used as SO₂ scrubbing agents.) There will be a minor increase in the burner's CO emission factor, offset by the decrease in trona feed rate and the CO emissions inherent in the trona calcination process. There will be no change in the VOC emission factor, which is almost entirely a function of trona feed rate (mass of VOC per unit of trona feed), but there will be a decrease in VOC emissions because of a decrease in the trona feed rate. There will be no increase in the PM₁₀ emission factor (mass of PM₁₀ per unit of airflow through the electrostatic precipitator). However, since there will be an increase in airflow, there will be an increase in the mass of potential PM₁₀ emissions. The emissions estimate is provided in Appendix A.

For the purpose of modeling these emissions, the SWWYTAF assumption of a NO/NO₂ split of 90 percent NO and 10 percent NO₂ is made. Therefore, a NO_x increase of 739 tpy is split into 434 tpy of NO ($739 \times 0.9 \times 30/46$) and 74 tpy of NO₂.

SECTION 3.0

IMPACT THRESHOLDS

The Wyoming Chapter 6 Permitting Requirements, Section 2(c)(iii), require that the impacts of any proposed facility not cause an exceedance of the Class I area increments. These increments are provided in Table 3.1. Moreover, the EPA has proposed (FR July 23, 1996, pp. 38,249 – 38,344) to allow for a demonstration of “insignificant impact,” which exempts a proposed facility from performing a full increment consumption analysis. (DEQ follows this procedure.) The levels of “insignificant impact” for NO_x and PM₁₀ are also provided in Table 3.1.

Table 3.1: Proposed Class I Area PSD Increments and Modeling Significance Concentrations

Pollutant	Increment (µg/m ³)	Significance (µg/m ³)
NO _x - annual average	2.5	0.1
PM ₁₀ - annual average	4.0	0.2
PM ₁₀ - 24-hour maximum	8.0	0.3

The USDA Forest Service has proposed (http://www.fs.fed.us/r6/aq/natarm/r4/bridger_ct.htm) a concern threshold for visual range and acid neutralization capacity. The impacts from the proposed Solvay Source 17 modification will be compared with an impact of at least 5 percent of natural background extinction (β_{ext}) for the individual source.

The second AQRV is acid deposition to surface waters. The threshold for “potential to impact” for acid deposition to wilderness lakes is the larger of the following:

- a relative change of 10 percent in ANC (eq) relative to baseline, and
- an absolute change in lake alkalinity of 1 µeq/l.

AQRV BASELINES

4.1 Visual Range Natural Background

The AQRV impact analyses incorporate baseline values. The visual range analysis will be prepared using two sets of background values, one based on the default values recommended by FLAG 2000, and one based on measured values as representative of "natural background." Suggested default values of the VR natural background are provided in the FLAG 2000 guidelines (Table 4.1). The measured constituent data for Bridger/Fitzpatrick is provided in Table 4.2.

Table 4.1: Natural Background Visual Range Parameters for the Bridger and Fitzpatrick Wilderness Areas as Proposed by FLAG (2000)

Season	Dry Hygroscopic (Mm ⁻¹)	Non-Hygroscopic (Mm ⁻¹)	Rayleigh Scattering (Mm ⁻¹)
Winter	0.6	4.5	10.0
Spring	0.6	4.5	10.0
Summer	0.6	4.5	10.0
Fall	0.6	4.5	10.0

Table 4.2: Summary of Measured Background Visual Range Parameters at the Bridger/Fitzpatrick IMPROVE Monitoring Site, 1988-1999

Season	Dry Hygroscopic (Mm ⁻¹)	Non-Hygroscopic (Mm ⁻¹)	Rayleigh (default)
Winter	0.81	1.96	10.0
Spring	1.99	3.41	10.0
Summer	1.91	6.10	10.0
Fall	1.40	3.60	10.0

The measured background VR values in Table 4.2 were calculated as follows. The data from 1988 to 2001 for the IMPROVE site at Bridger (BRID1) were obtained from the IMPROVE website. Only data up to 1999 were included in the analysis, since the 2000 and 2001 data had not undergone the highest level of quality control. Background levels were calculated for non-hygroscopic and hygroscopic compounds separately. Non-hygroscopic compounds include coarse particulate matter (PM₁₀-PM_{2.5}), elemental carbon, organic carbon, and soil particles. The hygroscopic compounds include ammonium nitrate and ammonium sulfate (IWAQM2, 1998). Summaries were based on the seasons (FLAG, 2000), specifically, winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September,

October, November). For each year-by-season combination the 20th-percentile value was calculated for the non-hygroscopic- and (dry) hygroscopic extinction values (units of Mm^{-1}). The background extinctions from 1988-1999 were calculated as the mean of the 20th-percentile values for each season. Only seasons with less than 50 percent of the data present were used in the analysis (Watson, 2002). Based on this criterion the winter season in 1988 was excluded from the analysis.

4.2 Lake Acid Neutralization Capacity Baseline

Two parameters need to be estimated to establish the baseline acid neutralizing capacity (ANC): baseline lake alkalinity ($\mu\text{eq/l}$) and estimated annual precipitation (m). Baseline lake alkalinity was calculated as the 10th-percentile lake alkalinity values for six lakes in the region (Forest Service, 2000). Data for the indicator lakes were provided by the USDA Forest Service (FS, 2002) and are shown in Table 4.3. The FS data set consists of a series of measurements of the baseline alkalinity, including duplicates, the number of which varied from year to year and lake to lake. The 10th-percentile values were calculated from the entire data set, covering up to an 18-year record (Table 4.3). Blanks and negative values were excluded from the calculation. Note that Upper Frozen Lake was recently added to the set of "indicator lakes." Data collection began in 1997, and to date there have been four samplings: one day per year in July or August for 1997, 1999, 2000, and 2001. For two of the samplings, a duplicate was also collected, making a total of six available readings with a range of $11.4 \mu\text{eq/l}$ as the highest to $1.3 \mu\text{eq/l}$ as the lowest. From this extremely small data set, the 10th-percentile most sensitive ANC value is 2.0, which is very low.

Table 4.3: Baseline ANC for Indicator Lakes

Lake	Period of Records	Number of Observations	10th-Percentile Most Sensitive Lake Alkalinities ($\mu\text{eq/l}$)
Black Joe	1984 -2001	186	60.0
Deep	1984 -2001	172	60.1
Hobbs	1984 -2001	197	70.3
Ross	1985 -2001	140	55.7
Lower Saddlebag	1986 -2001	147	55.8
Upper Frozen	1999 -2001	6	2.0

The second estimated parameter needed to calculate baseline ANC is the annual precipitation at the lakes under consideration (FS, 2000). The annual precipitation at the high elevation lakes in the Class I areas will be based on data from two deposition stations, the CASTNET site PN165 (Pinedale) and the NADP site WY06. These sites are located approximately 19km south from the site used to monitor visibility in the Bridger Wilderness Area (IMPROVE site BRID1) and

approximately 40 km from the western border of the Bridger Wilderness Area. Both sites are located at approximately 2,400 m ASL, at elevations similar to many of the lakes (SWWYTA, 2001).

SECTION 5.0

FACILITIES COMPETING FOR INCREMENT CONSUMPTION

In the event that the increment impact analysis for either PM or NO₂ (there will be no SO₂) shows that the Source 17 impacts are greater than the Class I area "significance" levels, shown in Table 3.1, a cumulative impact analysis will be performed. This analysis will provide the net impact from all source changes contributing to the increment consumption (negative or positive) on a per-pollutant basis. The increment-consuming or -expanding emissions will be calculated as the difference in emissions between the most recently available potentials in the DEQ permit files and the potentials as of the baseline date. The trigger dates for both major and minor sources are listed in Table 5.1.

Table 5.1: Baseline Trigger Dates for Southwest Wyoming

Pollutant	Major Source Baseline Date	Minor Source Baseline Date
PM	January 6, 1975	February 22, 1979
NO ₂	February 8, 1988	February 26, 1988

The domain for the sources to be considered in the cumulative impact analysis will be as follows:

- all major sources within the five-county region of Southwest Wyoming (Sweetwater, Uinta, Lincoln, Freemont, and Sublette),
- all minor stationary sources within a 50-km boundary of the Wilderness area (an oblong shaped minor source domain), and
- highway emissions within the minor source domain for US 287 and US 191.

Stationary source emission changes between 1988 and the present will be included according to the difference in potential emissions, while highway emission changes will be included according to actual emissions (1987 and 2001).

Actual gas well field emissions (construction, development, and production) within the minor source domain will be included. The inventory will be developed in a statistical and spatially gridded manner similar to that used for SWWYTAF. The same per-well emission factors will be used.

Urban emissions will not be included because they are extremely small. From the Northeast Wyoming Emissions Inventory (Air Sciences Inc., 2002), the change in urban NO_x emissions from 1987 to 2000 was 12 tons per year (increase) for a 1987 population of 104,000. The 1995 population total of Riverton, Lander, and Pinedale combined was 18,500. Assuming the

population changes are similar and consumption habits are similar, the NO_x emissions from these three towns would change by about 2 tons per year, which is insignificant compared with the changes in compression in the domain.

DISPERSION ANALYSIS

6.1 Model Selection

Because the Class I areas are more than 50 km from the Solvay facility, long-range transport is applicable. The Interagency Workgroup on Air Quality Modeling Phase 2 Summary Report and Recommendations for Modeling Long-Range Transport Impacts (IWAQM2), Federal Land Managers Air Quality Related Values Work Group Phase I report (FLAG, 2000), recommends the use of the CALPUFF modeling system (Version 5.4) for evaluating impacts on a regional scale. CALPUFF is a multi-layer, gridded, non-steady-state lagrangian puff dispersion model that can simulate the effects of temporally and spatially varying meteorological conditions on pollutant transport and dispersion.

At DEQ's request, the Southwest Wyoming Technical Air Forum (SWWYTAF) 1995 CALPUFF analysis (February 2001) will be used as the basis for this analysis. The objective of the SWWYTAF study was to evaluate the degree of degradation of air quality, visibility, and other AQRVs in the Fitzpatrick and Bridger Class I areas caused by all upwind sources (natural and anthropogenic), and to evaluate the performance of the non-steady-state CALPUFF dispersion model and its associated wind field model CALMET in predicting the measured air quality and AQRVs during 1995 in the Class I areas. Air Sciences Inc. has a copy of the SWWYTAF data files (2001) that were provided by the DEQ.

Details of the SWWYTAF study are summarized below, with emphasis on proposed changes from the SWWYTAF approach.

6.2 Geophysical Data

The modeling domain and geophysical data from the SWWYTAF study will be used. The SWWYTAF modeling domain includes the southwestern portion of Wyoming, northeastern Utah, southeastern Idaho, and northwestern Colorado, and consists of 116 by 100 grid cells at a 4-km spacing, which corresponds to a domain of 464 km in X by 400 km in Y. The southwest corner has the coordinates of -335.0 in X and -258.0 in Y. The coordinate system is a Lambert Conic Conformal (LCC) coordinate system with standard latitudes of 30 and 60 degrees, reference latitude of 42.55 degrees, and reference longitude of 108.55 degrees. The SWWYTAF terrain data were extracted from a 1-degree Digital Elevation Model (DEM), which has an approximate grid spacing of 90 meters. The land use data were extracted from the USGS composite theme grid (CTG) 1:250,000 (1 degree) scale files. These data were processed for the SWWYTAF study and are contained in the GEOSWY.DAT file.

6.3 Meteorological Data

In the SWWYTAF study, the time-varying large-scale wind flow was derived using a combination of the coarse-grid (20 km) MM5 simulations, direct surface observations, and vertical sounding. The MM5 data were generated by the National Center for Atmospheric Research (NCAR) using the PSU/NCAR Mesoscale Model System, Version II. The data have 11 standard levels (surface, 1000, 850, 700, 500, 400, 300, 250, 200, 150, and 100 hPa) and include two-dimensional snow cover, the sea surface temperature, the sea level pressure, and three-dimensional variables of temperature, geo-potential height, U and V components of wind, and RH.

In addition to the MM5 data, CALMET requires hourly surface observations of wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation type (e.g., snow, rain). For SWWYTAF, a total of 22 surface stations were used and are listed below. Hourly observations from these stations were processed for SWWYTAF and will be used in this analysis.

Table 6.1: Surface Meteorological Data Stations Used in the SWWYTAF Analysis

Surface Station	Source
Casper, WY	NWS
Cheyenne, WY	NWS
Denver, CO	NWS
Lander, WY	NWS
Grand Junction, CO	NWS
Pocatello, ID	NWS
Rock Springs, WY	NWS
Salt Lake City, UT	NWS
Rawlins, WY	FAA
Riverton, WY	FAA
Baggs, WY	Mt. Zirkel Study
Craig, CO	Mt. Zirkel Study
TG Soda Ash	Industrial Site
OCI	Industrial Site
Naughton	Industrial Site
General Chemical	Industrial Site
Amoco	Industrial Site
Exxon	Industrial Site
Pinedale	NDDN
Centennial	NDDN
Yellowstone NP	NPS
Craters of the Moon NP	NPS

CALMET also requires twice-daily observations of the vertical profiles of wind speed, wind direction, temperature, and pressure. For SWWYTAF, there were four sites observed for upper air data, which are listed below. The data from these sites were processed for SWWYTAF and will be used in this analysis.

Table 6.2: Upper Air Meteorological Data Stations Used in the SWWYTAF Analysis

Upper Air Station	Source
Denver, CO	Twice-daily upper air (TD6201) soundings (NWS)
Grand Junction, CO	Twice-daily upper air (TD6201) soundings (NWS)
Lander, WY	Twice-daily upper air (TD6201) soundings (NWS)
Salt Lake City, UT	Twice-daily upper air (TD6201) soundings (NWS)

In order to calculate wet deposition rates, CALMET requires hourly precipitation rates across the domain. Generally, most precipitation stations tend to be at lower elevations. However, because the presence of high terrain can substantially enhance the amount of precipitation, the use of only the lower level stations can result in an underestimate of the precipitation in areas of elevated terrain. Therefore, in the SWWYTAF study, additional sources of precipitation data were used to properly characterize the precipitation patterns in the SWWYTAF domain. For SWWYTAF, 4-km resolution PRISM climatological precipitation data were used to convert the 20-km MM5 predictions to a 4-km resolution and to produce a more representative terrain-induced spatial pattern. Likewise, the observed hourly precipitation data were scaled by the PRISM annual values for consistency. The scaled MM5 data were combined with the scaled hourly precipitation observations to produce the final precipitation field. This scaled SWWYTAF precipitation file will be used in this analysis.

In CALPUFF, the RH at a point in the domain is obtained from the nearest surface station record. Because most surface stations tend to be at elevations much lower than the Class I areas, the RH at the surface site may not be representative of the RH in the Class I areas. Air Sciences Inc. proposes to incorporate terrain-based RH as an input into CALPUFF. The terrain-based RH will be derived using surface level RH from the MM5 data set at nodes in areas of elevated terrain or that are far from a surface station. These data may be spatially averaged (not vertically) if there are considerable discrepancies between the MM5 and surface station RH values. The new terrain-based RH values will be introduced into CALPUFF as a series of pseudo surface stations added to the surface observation file. The resulting VIS.DAT file from CALPUFF will be used in the visibility calculations, resulting in a consistent RH record for all calculations.

This approach differs slightly from the SWWYTAF approach and is proposed herein because the SWWYTAF approach is not internally consistent. SWWYTAF used one scheme for the visual range impacts and another for the atmospheric chemical transformations. Secondly, the

SWWYTAF schemes are not consistent with guideline (IWAQM2, 1998) regulatory application methods.

6.4 Wind Field Generation

The time-varying wind fields will be generated using the CALMET program and the SWWYTAF geophysical data file (GEOSY.DAT), MM5 data, surface data file (with RH pseudo stations added), upper air data files, and scaled precipitation data. The only difference in the files used for this analysis and the files used for SWWYTAF will be the inclusion of the extracted RH data into the surface file. CALMET will be run using the model setting as used in SWWYTAF.

Since the SWWYTAF wind fields were thoroughly reviewed, a consistency check will be made to verify that the wind fields generated for this application are the same as those generated for SWWYTAF.

6.5 CALPUFF Settings and Execution

Once the CALMET wind fields are completed, the CALPUFF model will be run to calculate concentrations, and wet and dry deposition rates of all relevant pollutants. For this analysis, the RIVAD/AM3 chemistry will be used, which will include SO₂, SO₄, NO, NO₂, HNO₃, NO₃, and fine particulate species.

The Class I area receptors from the SWWYTAF study will be used. These receptors are placed every 2 kilometers along the boundary of each Class I area and on a 2-km resolution grid within each Class I area.

Building downwash parameters, as estimated by the Building Profile Input Program (BPIP Version 95086), will be incorporated into the CALPUFF analysis.

Hourly ozone data from the SWWYTAF study will be used. This data includes ozone measurements from six stations: Pinedale, WY; Centennial, WY; Yellowstone NP, WY; Craters of the Moon NP, ID; Highlands, UT; and Hayden, CO.

CALPUFF requires a domain average ambient ammonia (NH₃) concentration. The IWAQM2 recommended value of 1 ppb, representative of arid climates, is proposed for use herein. Given the arid nature of the land and the low NH₃ emission fluxes (< 1 ton/sq. mile/yr) in the modeling domain, the 1 ppb value would be reasonable for this application. (See NH₃ emissions density map from EPA's National Air Pollution Emissions Trends Update, 1970-1997 [1998]; <http://www.epa.gov/ttn/chief/trends/trends98/>.) This proposed value is corroborated by a SWWYTAF impact estimate of 1.1 ppb region-wide, performed as an ancillary modeling exercise and based upon a region-wide NH₃ emission rate of approximately 0.23 ton/sq. mi/year.

The CALPUFF module will be run using the appropriate Table 2.2 short- or long-term emissions to calculate pollutant concentration, and wet and dry deposition rates at each receptor in the Class I areas.

6.6 PSD Increment Comparison

If Source 17 increases the trigger "significance," a cumulative increment analysis will be needed, and all domain increment-consuming emissions (as described in Section 5.0) will be modeled.

Results of the NO_x and PM incremental impacts will be compared with the allowable PSD increments listed in Section 3.0.

SECTION 7.0

AQRV IMPACT ESTIMATION

The AQRV impact estimates will be performed on the Source 17 emission increases as defined in Section 2.0.

7.1 Visual Range

The CALPUFF module will be run using the appropriate short- or long-term Source 17 emissions to calculate pollutant concentrations at each receptor in the Class I areas. CALPUFF will also be set up to output an RH file (VIS.DAT) for use in the visibility calculation. Then, the CALPOST processor will be used with the concentration and VIS.DAT files to calculate the light extinction (visibility impairment) in the Class I areas. The results will be compared with the thresholds described in Section 3.0.

For the visibility impact calculation in SWWYTAF, the maximum RH used in the particle growth curve (RHMAX) was set at 90 percent. IWAQM2 recommends that RHMAX be set to 98 percent. In a recent review, Watson 2002 notes, "For RH from 90 to 100 percent, a range that is imprecisely measured by most RH sensors, light scattering usually skyrockets. These high RH periods are often removed by scientists before comparing calculated and measured extinction values." ... "Surface-based RH measurement of 98-100 percent imply the sensor is in a fog or cloud ..."; and "... RH > 95 percent is not well quantified even with the best continuous sensors, and many automated in long-term weather networks are not of the highest caliber." Given the inaccuracy of the RH measurements above 95 percent and that RH values above 97 percent are likely affected by clouds or fog (natural obscurants), Air Sciences Inc. proposes a RHMAX of 95 percent for this application. We expect that even with RH values at around 90 percent that there will be precipitation in the area, especially during the summertime afternoons, when thunderstorms are prevalent.

As mentioned in Section 6.3, the SWWYTAF modified VIS.DAT file will not be used in this analysis. Rather, terrain-based RH values will be inputted into CALPUFF as pseudo stations, and the resulting CALPUFF VIS.DAT file will be used. This will result in a consistent RH record for both the chemistry and visibility calculations.

7.2 Acid Deposition

Sulfur and nitrogen deposition rates will be extracted from the CALPUFF output file using the POSTUTIL and CALPOST programs. POSTUTIL takes the CALPUFF wet and dry deposition files with the CALPUFF defined species (i.e., SO_2 , SO_4^{2-} , NO_2 , HNO_3 , $((\text{NH}_4)_2\text{SO}_4)$) and calculates S and N deposition rates. The S and N deposition rates in the POSTUTIL output file ($\text{g m}^{-2} \text{s}^{-1}$) are calculated using the conversion factors according to the guidelines provided with POSTUTIL:

$$\text{S deposition (g m}^{-2} \text{ s}^{-1}) = 0.500 \cdot \text{SO}_2 + 0.333 \cdot \text{SO}_4^{2-}$$

$$\text{N deposition (g m}^{-2} \text{ s}^{-1}) = 0.304 \cdot \text{NO}_2 + 0.222 \cdot \text{HNO}_3 + 0.452 \cdot \text{NO}_3^{-1} + 0.292 \cdot \text{SO}_4^{2-}$$

Although not shown in the equation above, the nitrogen from background ammonium is also included in the N deposition rate. CALPOST will be used to extract the S and N deposition for all receptors. One specific receptor will be established for each of the lakes, based on their latitude and longitude. The CALPUFF-calculated wet and dry deposition is further processed using the Forest Service, 2000 screening methodology. Precipitation will be estimated using the routine discussed in Section 4.2.

Results of this deposition analysis will be compared with the Section 3 thresholds.

SECTION 8.0

SOLVAY CLASS I PROTOCOL REFERENCES

FLAG, *Federal Land Managers' Air Quality Related Values Workshop (FLAG) Phase I Report*, December 2000)

EPA, FR July 23, 1996, pp. 38,249 – 38,344

IWAQM2, EPA-454/R-98-019, 1998

J.G. Watson, *Visibility: Science and Regulation*, Air & Waste Management Association, 2002, 52, pp. 628-713

Forest Service, *Users Guide - Screening Methodology for Calculating ANC Change to High Elevation Lakes*, 2000

Forest Service, Excel data transfer from Terry Svalberg, Forest Service, Pinedale WY, to Rodger Steen, Air Sciences Inc. 9/3/2002

SWWYTAF, Earth Tech, Concord MA, *The Southwest Wyoming Regional CALPUFF Air Quality Modeling Study - Final Report including Project Data Files*, February 2001

Air Sciences Inc., *Northeast Wyoming Emissions Inventory*, for Wyoming DEQ, January 2002

APPENDIX A

Proposed Source 17 Emissions Evaluation



DENVER • PORTLAND

ENGINEERING
CALCULATIONS

PROJECT TITLE: Solvay Minerals Inc.	BY: E. Memon		
PROJECT NO: 170-4	PAGE: 1	OF: 4	SHEET: 1
SUBJECT: Calciners A and B Emissions	DATE: November 15, 2002		

CALCINERS A & B (SOURCE # 17)

SOURCE CHARACTERISTICS

	Units	Existing	Modified
Control Device		ESP	ESP
Exhaust Flow Rate	ACFM	312,000	650,000
Trona Feed Capacity	TPH	400	320
Thermal Capacity	MMBtu/hr	500	400
Operation Schedule	hrs/yr	8,760	8,760
Fuel Type		Natural Gas	Sub-bituminous Coal

POTENTIAL EMISSION DIFFERENCE (tpy)

Pollutant	Existing	Modified	Difference
PM ₁₀	97.7	180.2	82.5
NO _x	131.4	788.4	657.0
CO	6,675.1	5,532.7	-1,142.4
VOC	3,398.9	2,714.0	-684.9

EMISSION DIFFERENCE FOR COMPARISON TO MAJOR SOURCE TRIGGER THRESHOLDS (tpy)

Pollutant	Existing Actual ^a	Modified PTE	Difference
PM ₁₀	32.4	180.2	147.8
NO _x	49.2	788.4	739.2
CO	1,077.4	5,532.7	4,455.3
VOC	1,199.2	2,714.0	1,514.7

^a Average of years 2,000 and 2,001 actual emissions, as reported to WYDEQ



DENVER • PORTLAND

ENGINEERING CALCULATIONS

PROJECT TITLE: Solvay Minerals Inc.	BY: E. Memon		
PROJECT NO: 170-4	PAGE: 2	OF: 4	SHEET: 1
SUBJECT: Calciners A and B Emissions	DATE: November 15, 2002		

MODIFIED CONDITIONS CALCINERS A & B (SOURCE # 17)

SOURCE CHARACTERISTICS

Furnace Type	Detroit Stoker Underthrow Fuel (Pneumatically Assisted) Spreader		
Control Device	ESP		
Exhaust Flow Rate	650,000 ACFM	Solvay	
	240,000 DSCFM	Solvay	
Trona Feed Capacity	320 TPH	Solvay	
Thermal Capacity	400 MMBtu/hr	Solvay	
Operation Schedule	8,760 hrs/yr	Solvay	

FUEL DATA

Fuel Type	Sub-Bituminous Coal	Solvay
Heating Value	10,150 Btu/lb	Solvay
	20.3 MMBtu/ton	
Fuel Consumption	19.7 ton/hr	
	400 MMBtu	ton
	hr	20.3 MMBtu

EMISSION FACTORS

Pollutant	Emission Factor	Manufacturer Guarantee for ESP			
PM ₁₀	0.02 grain/DSCF				
	41.1 lb/hr	0.02 grain	240,000 DSCF	1 lb	60 min
		DSCF	min	7000 grain	hr
NO _x	0.45 lb/MMBtu	Manufacturer Guarantee			
CO	5 lb/ton-coal	AP-42, Table 1.1-3 (Spreader Stoker)			
	0.19 lb/MMBtu	AP-42, Table 1.1-3 (Based on 26 MMBtu/ton)			
CO (process)	3.7 lb/ton-trona	See Calculations on Sheet 4			
VOC	0.05 lb/ton-coal	AP-42, Table 1.1-19 (Spreader Stoker)			
VOC (process)	1.9 lb/ton-trona	See Calculations on Sheet 4			

POTENTIAL EMISSIONS

Pollutant	lb/hr	tpy
PM ₁₀	41.1	180.2
NO _x	180.0	788.4
CO	1,263.2	5,532.7
VOC	619.6	2,714.0

STACK PARAMETERS

Location	603,686 m East
	4,594,808 m North
Stack Height	55.02 m
Stack Diameter	3.66 m
Exhaust Temperature	400 °F
Exhaust Velocity	29.2 m/s

Numbers in blue are entries, and black are calculations



ENGINEERING CALCULATIONS

DENVER • PORTLAND

PROJECT TITLE: Solvay Minerals Inc.	BY: E. Memon		
PROJECT NO: 170-4	PAGE: 3	OF: 4	SHEET: 1
SUBJECT: Calciners A and B Emissions	DATE: November 15, 2002		

EXISTING CONDITIONS

CALCINERS A & B (SOURCE # 17)

SOURCE CHARACTERISTICS

Control Device	ESP	Permit 30-126
Exhaust Flow Rate	312,000 ACFM	Permit 30-126
Trona Feed Capacity	400 TPH	Permit 30-126
Thermal Capacity	500 MMBtu/hr	Permit 30-126
Operation Schedule	8,760 hrs/yr	

POTENTIAL EMISSIONS

Pollutant	lb/hr	tpy	
PM ₁₀	22.3	97.7	Permit 30-126
SO ₂	0.0	0.0	Permit 30-126
NO _x	30.0	131.4	Permit 30-126
CO	1,524.0	6,675.1	Permit CT-1347
VOC	776.0	3,398.9	Permit CT-1347

ACTUAL EMISSIONS ^a

Pollutant	2000 tpy	2001 tpy	Average tpy
PM ₁₀	40.2	24.5	32.4
NO _x	64.5	33.9	49.2
CO	1,322.0	832.8	1,077.4
VOC	1,446.1	952.3	1,199.2

^a Provided by Solvay Minerals Inc. as reported to WYDEQ as per requirement of permit 30-126

STACK PARAMETERS

Location	603,686 m East
	4,594,808 m North
Stack Height	55.02 m
Stack Diameter	3.66 m
Exhaust Temperature	375 °F
Exhaust Velocity	13.41 m/s

Numbers in blue are entries, and black are calculations



ENGINEERING
CALCULATIONS

DENVER • PORTLAND

PROJECT TITLE: Solvay Minerals Inc.	BY: E. Memon		
PROJECT NO: 170-4	PAGE: 4	OF: 4	SHEET: 1
SUBJECT: Calciners A and B Emissions	DATE: November 15, 2002		

CALCULATIONS TO ESTIMATE CO AND VOC EMISSIONS FROM PROCESS ONLY

EXISTING CONDITIONS

Thermal Capacity	500 MMBtu/hr	Permit 30-126
Trona Feed Capacity	400 TPH	Permit 30-126
Total CO (Process + Combustion) Emissions	1524 lb/hr	Permit CT-1347
CO (Natural Gas Combustion) Emissions	84 lb/MMScf	AP-42 Table 1.4-1
	0.08 lb/MMBtu	(Based on 1,020 Btu/Scf)
	41.2 lb/hr	
CO (Process) Emissions	1482.8 lb/hr	
	3.7 lb/ton-ore	
Total VOC (Process + Combustion) Emissions	776.0 lb/hr	Permit CT-1347
VOC (Natural Gas Combustion) Emissions	5.5 lb/MMScf	AP-42 Table 1.4-2
	0.005 lb/MMBtu	(Based on 1,020 Btu/Scf)
	2.7 lb/hr	
VOC (Process) Emissions	773.3 lb/hr	
	1.9 lb/ton-ore	

Numbers in blue are entries, and black are calculations



Detroit Stoker Company

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E-mailed only: dolly.potter@solvay.com

February 11, 2003

Ms. Dolly Potter
Solvay Minerals, Inc
P.O. Box 1167
Green River, WY 82935

Subject: Solvay Minerals, Inc
Green River, WY
Detroit Stoker Company Job No. ES-111-RG-969

Dear Ms. Potter,

Pursuant to yesterday's telephone conversation regarding SNCR (Selective Non-Catalytic Reaction), Detroit Stoker Company offers the following information.

Detroit Stoker Company is not a designer or provider of Urea/ammonia based SNCR systems. However, we do have experience with these systems in the industrial boiler market, at both domestic and foreign locations. These experiences are predominately biomass fired facilities, but we also have experience with coal fired facilities.

Detroit Stoker Company has been involved in many requests for NOx reduction for both new and existing facilities. With those facilities having an SNCR system we have been successful at fully removing the SNCR and using a variety of technologies including staged combustion systems, flue gas recirculation and reburn technologies to obtain the necessary NOx reductions. Therefore Detroit's experience is based on replacement of SNCR's rather than adding on additional processes. It is also noteworthy that our experience is actually for boilers, rather than refractory lined furnaces. In fact, Detroit Stoker Company has no knowledge of an SNCR system in operation for a refractory lined process furnace.

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An SNCR's effectiveness is dependent on a particular temperature window and residence time (mixing) at those temperatures. Given that we have no experience with using an SNCR on a refractory lined process furnace it would be difficult to know if an SNCR would provide any NOx reduction. However, we are reasonably confident in saying that any reduction would not likely approach a 35-40% reduction value demonstrated on industrial coal fired boilers using an SNCR. Again our experience has been to replace an SNCR due to the operating costs, issues of ammonia slip and other operation/maintenance issues associated with SNCR's rather than co-operating with other "in-furnace" technologies.

We trust this information has been helpful and should you have any additional questions or concerns, please do not hesitate contacting either Dave Cron or me.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert S. Morrow". The signature is fluid and cursive, with the first name "Robert" and last name "Morrow" clearly distinguishable.

Robert S. Morrow
Manager-Engineering

CC: William Stuble
Solvay Minerals Inc
bill.stuble@solvay.com